REMARKS

In the Office Action dated September 25, 2002, claims 1-5, 10 and 13 were rejected under 35 U.S.C. §102(a) as being anticipated by "Wo (702)" (Applicants assume the Examiner is referring to PCT Application WO 97/26702 and will hereinafter refer to that reference as the '702 PCT Application), or Patent Abstracts of Japan '478.

By the present Amendment, each of independent claims 1 and 13 has been amended to include the affirmatively-claimed element of a rigid, non-articulated mechanical connection between each of the electromechanical drive elements and the drive ring. Each of the independent claims has been further amended to state that the drive ring is non-deformable and that the circulatory offset displacement occurs with no deformation of the drive ring. Support for this added language is present in the specification as originally filed at page 6, lines 7-10 and page 14, lines 2-4. Moreover, the welding points for the tappet 6 are clearly shown in Figure 1 and are referenced 9 therein.

The phrase "rigid, non-articulated mechanical connection" is to mean a fixed, non-movable connection that does not include any joints or parts that are movable relative to each other.

As set forth in the discussion below, Applicants believe this language that has been added to the independent claims is sufficient to patentably distinguish those claims over the teachings of the references relied upon by the Examiner in the present Office Action, as well as the references previously made of record. For this reason, Applicants believe it is not necessary to state in the independent claims that the electromechanical drive elements are stationarily mounted, nor is it necessary to

limit the claims to the embodiment of Figures 15A and 15B, wherein the drive elements are disposed in the interior of the drive ring. Language relating to these features therefore has been removed from the independent claims, and relegated to dependent claims which are added herein.

As is apparent from the extensive prior art of record, the present Applicants have departed from the conventional thinking in the art with regard to the manner by which force, and thus power, are transferred from the drive elements to the drive ring. In all of the references of record, the connection between the drive elements and a drive ring (in those references where a drive ring is employed) occurs either by means of an articulated joint, or by means of a non-rigid contact between the drive elements and a drive ring, such as a momentary contact which is made or broken dependent on the motion of the drive ring. In fact, it is the position of the Applicants that in those references wherein only momentary contact takes place between the drive elements and the drive ring, such contact is not even a "connection" as set forth in claims 1 and 13.

In other references of record, the drive ring, or a component which the Examiner has alleged to correspond to the claimed drive ring, is intentionally made to be deformable, and the motion which results in the torque output occurs only because of this deformability of the drive ring. The present Applicants have surprisingly found that by making the aforementioned connections between the drive elements and the drive ring rigid and non-articulated, and by making the drive ring non-deformable, so that the aforementioned offset circulatory motion occurs with no deformation of the drive ring, a higher output torque can be obtained due to the overall stiffness of the motor. Not only is the power transmission factor higher, but

because there is less "slop" in the overall operation of the motor, the rotation of the rotor can be more accurately controlled. Making the overall structure of the motor stiffer by the aforementioned design features set forth in claims 1 and 13, therefore, is not merely a matter of design choice, but in fact has demonstrable and significant advantages. More importantly, for the purpose of assessing patentability, this manner of intentionally imparting stiffness to the overall structure of the motor is contrary to the conventional thinking in the art as exemplified by the references of record.

The '702 PCT Application discloses a motor having a first member 12 which forms the stator. The first member 12 is surrounded by a second member 15 formed by a cylindrical sleeve, which forms the rotor of the motor. The cylindrical sleeve 15 is, in turn, attached to an output shaft 17. Additionally, the sleeve 15 carries a bearing ring 16 to which inwardly directed forces are applied by linear actuators 21. This embodiment is shown in Figure 1, and in other embodiments shown in Figures 3 and 4, actuators 32-35 and 42-45 are employed, connected to a drive mechanism or ring 31 or 34 by sliding means 37.

Therefore, not only is the basic operation of the motor disclosed in the '702 PCT Application different from that disclosed and claimed in the present application, but also there is no explicit teaching in the '702 PCT Application as to how the linear actuators (in any of the embodiments) are connected (or even if they are connected) to the periphery of the bearing ring 16 or the stators 31 or 41. The only information on this point provided in the '702 PCT Application is that the actuators are connected to those elements at right angles, but the structure or components forming the connection is nowhere discussed.

Moreover, it can be assumed that the advantage of providing a stiff structure for force transmission from the actuators to the rotor, as in the subject matter of the present application, was not appreciated by the inventor in the '702 PCT application, since there is no mention thereof anywhere in that reference. To the contrary, the sliding means 37 which form the only the means for connecting the actuators to the stator disclosed in the '702 PCT Application, preclude a direct application of force from the actuators to the stator or bearing ring. The use of the sliding means 37 inherently results in a loss of energy due to the movements of the sliding means 37.

The piezoelectric motor disclosed in Patent Abstracts of Japan '478 employs an *elastic* stator ring 10. As this elastic ring 10 is acted upon by successive actuators, a traveling bulge proceeds in a circular path along the inner side of the rotor ring 11, thereby causing rotation of the rotor ring 11.

As discussed above, each of the independent claims of the present application states that the drive ring is non-deformable, in direct contradiction to the use of the elastic ring in the Japanese reference.

Therefore, none of claims 1-5, 10 or 13 is anticipated by either the '702 PCT Application or Patent Abstracts of Japan '478.

Claims 1-5, 10, 11 and 13-15 also were rejected under 35 U.S.C. §103(a) as being unpatentable over Nygren, Tamura, Ueyama or German '996 in view of Lindemann et al.

In the "diagrammatical illustrations" of Figs. 1A through 1D in Nygren, there is no explicit showing of structure for transmitting energy from the actuators to the drive ring, and therefore these figures and the accompanying written description in Nygren

do not inform a person of ordinary skill in the art of any type of connection between the actuators and the drive ring.

Elsewhere, Nygren teach that the rotor 30 is connected to and surrounded by a mounting 40, by means of a support 56 that is attached to the mounting 40 via a web 58 and a second support 60 via a flexure membrane 62. The actuator elements are disposed in a tangential plane relative to the surface of the rotor, and the oscillations produced by the piezoelectric motor therefore are transmitted through the entire surrounding body before causing rotation of the rotor 30. Again, therefore, this inventor has not appreciated the advantages obtained by an overall stiff force-transmitting structure as disclosed and claimed in the present application.

In the Tamura reference, it can easily be seen that the connection between the piezoelectric elements 2a and the drive ring 3 is accomplished via Bimorphs 1 and 2 and a pivot plate 4. The Tamura reference, therefore, does not teach or suggest a rigid, non-articulated connection between the actuators and the drive ring, and in fact teaches away from this concept.

There are two Ueyama references of record (Ueyama '792 and Ueyama '233), and the Examiner did not specify which of these two references he is relying on in the aforementioned rejection.

Ueyama '792 discloses an electromechanical motor having electrostrictive elements 6 which produce a thrust tangentially toward the rotor or shaft, as shown in Figures 1-3. When the electrostrictive element 6 is activated by a control circuit, and is therefore extended in the tangential direction, as indicated by arrow A in Figure 3, the connecting portion 10 of the support shaft is pulled in the direction of the arrow. The resulting shear and pull, in general, produces the precessional movement of the

plate 4 which, through other elements, ultimately causes the rotary plate 22 to rotate at a very slow speed.

Therefore, Ueyama '792 does not provide any teaching with respect to a rigid, non-articulated connection between the actuators and a drive ring, as disclosed and claimed in the present application.

In the Ueyama '233 reference, piezoelectric elements apply a radial force to a shaft by acting through a contact ring 10 which is rotationally supported by a bearing 8 within a cylindrical member 7, as described in the first paragraph of column 3 of Ueyama '233. Again, therefore, there is no direct connection taught in Ueyama '233 between the actuators and the driven element.

Equally as important, neither of the Ueyama references evidences an appreciation of the advantages obtained by adding an overall stiff force-transmitting structure, as disclosed and claimed in the present application.

The German '996 reference discloses an electromechanical motor having piezoelectric elements that are mechanically attached to a housing 12 by elastic couplings 42, as described in the last paragraph at column 2. Again, therefore, this reference does not employ a rigid, non-articulated connection between the actuator and the driven element, and in fact teaches away from this concept and its associated advantages.

Therefore, none of the primary references which formed the basis for this rejection teaches or suggests a rigid, non-articulated mechanical connection between the actuators and the drive ring, as disclosed and claimed in the present application. The secondary reference (Lindemann et al.) does not provide any teaching, suggestion or motivation to provide such a connection.

The Lindemann et al. reference discloses an ultrasonic driving element having a ring that is rotated by a stack of piezoelectric layers in the form of a number of turrets. Successive actuation or activation of these turrets produces a traveling wave. Lindemann et al. teach at column 6, line 58 through column 7, line 5, and in Figures 4d and 4e, that the turrets can be arranged inside of a cylinder or outside of a cylinder. It is not seen how the operation of such turrets as taught by Lindemann et al. could even be employed in place of any of the actuators in the aforementioned Nygren, Tamura, Ueyama '792, Ueyama '223 or German '996 references, since all of those references operate in a completely different structural manner from Lindemann et al. Applicants acknowledge that in order to support a rejection under 35 U.S.C. §103(a) it is not necessary for a secondary reference to by physically combinable into a primary reference. Nevertheless, the Examiner must demonstrate some reason as to why a person of ordinary skill in the art would expect an operational structure to result from the Examiner's proposed combination, otherwise, this is merely wishful thinking or a merging of concepts or an "obvious to try" argument, all of which have been discredited as a basis for a proper rejection under 35 U.S.C. §103(a). Merely locating the conceptual teaching in Lindemann et al. that the turrets can be disposed inside or outside of a cylinder does not teach, motivate or induce a person of ordinary skill in the art to modify any of the primary references in order to arrive at the subject matter of any claim of the present application. None of the claims of the present, therefore would have been obvious to a person of ordinary skill in the art under the provisions of 35 U.S.C. §103(a) based on the teachings of any of these references.

Applicants note with appreciation that claim 12 was stated to allowable if rewritten in independent form, however, in view of the arguments for patentability presented herein with regard to claim 1, from which claim 12 depends, claim 12 has been retained in dependent form at this time. Moreover, since claim 15 is the method counterpart to claim 12, it is not understood why the Examiner indicated claim 12 would be allowable if rewritten in independent form, but not claim 15 as well. In any event, all claims of the application are submitted to be in condition for allowance in view of the above arguments for patentability.

Early reconsideration of the application is therefore respectfully requested.

Submitted by,

Steven H. Noll (Reg. 28,982)

SCHIFF, HARDIN & WAITE
CUSTOMER NO. 26574
Patent Department
6600 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606
Telephone: 312/258-5790
Attorneys for Applicants.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please amend claim 1 as follows:

1. (Twice amended) An electromechanical motor comprising:

two [stationarily mounted] electromechanical drive elements respectively producing linear displacements;

<u>a non-deformable drive ring;</u>

[a drive ring having an interior in] <u>rigid, non-articulated</u> mechanical [connection with] said drive elements <u>to said drive ring</u> for causing said drive ring to execute a circulatory displacement motion by a combination of said linear displacements <u>with no deformation of said drive ring</u>; and

a shaft in rolling line contact with [an exterior of] said drive ring, said shaft being rotated by said circulatory displacement motion of said drive ring.

Please amend claim 3 as follows:

3. (Amended) An electromechanical motor as claimed in claim 1 wherein said drive ring is circular, and wherein said [drive elements are mechanically attached to said ring so] <u>mechanical connections are disposed</u> that said respective linear displacements act radially on said drive ring.

Please amend claim 5 as follows:

5. (Amended) An electromechanical motor as claimed in claim 1 wherein said circulatory displacement motion takes place in a motion plane, and further comprising at least one further electromechanical drive element <u>and further rigid, non-articulated mechanical connection connecting said further electromechanical drive element to said drive ring</u>, said two electromechanical drive

elements and said at least one further electromechanical drive element being disposed relative to each other at equal angles in said motion plane.

Please amend claim 11 as follows

11. (Amended) An electromechanical motor as claimed in claim 1 further comprising at least two further electromechanical drive elements which respectively produce linear displacements, [and] at least one non-deformable further drive ring; at least two further rigid non-articulated connections respectively connecting [in mechanical connection with] said at least two further drive elements to said further drive ring, said at least one further drive ring being caused to execute said circulatory displacement motion with no deformation of said further drive ring by a combination of the linear displacements of said at least two further drive elements, and said shaft being in rolling line contact with each of said drive ring and said at least one further drive ring, said shaft being rotated by the circulatory displacement motions of said drive ring and said at least one further drive ring.

Please amend claim 13 as follows:

13. (Twice amended) A method for operating an electromechanical drive, comprising the steps of:

[stationarily mounting] providing two electromechanical drive elements and a non-deformable drive ring;

placing [a] said drive ring in rigid, non-articulated mechanical connection with said two electromechanical drive elements;

producing respective linear displacements with said drive elements for causing said drive ring to execute a circulatory displacement motion

with no deformation of said drive ring by a combination of said linear displacements; and

placing a shaft in rolling line contact with [an exterior of] said drive ring and rotating said shaft with said circulatory displacement motion of said drive ring.

Please amend claim 15 as follows:

15. (Amended) A method as claimed in claim 13 wherein drive elements are first drive elements and wherein said drive ring is a first drive ring, and comprising the additional steps of:

providing two second electromechanical drive elements and a non-deformable second drive ring;

placing said two second electromechanical drive elements in mechanical connection with [a] said second drive ring;

producing respective linear displacements with said second drive elements and thereby causing said second drive ring to execute said circulatory displacement motion with no deformation of said second drive ring; and

placing said second drive ring in rolling line contact with said shaft for rotating said shaft by the respective circulatory displacement motions of both of said first drive ring and said second drive ring.

CHI_DOCS2\ 665202.1